

July 2010 Climate Summary for Southwest Lower Michigan

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Overview

The weather of July 2010 was quite the opposite of July 2009 over Southwest Lower Michigan. One of the coldest Julys on record occurred in 2009 while July 2010 was in the top 15 warmest on record.

At the primary climate stations, Muskegon had the second warmest July on record with a mean temperature of 75.0 degrees, just behind the 75.9 degree record set in 1955. Lansing had the sixth warmest July on record with a mean of 74.6 degrees. The warmest July in Lansing occurred in 1955 with a mean of 77.7 degrees. At Grand Rapids the mean of 75.5 degrees was the eleventh warmest on record. The warmest July on record for Grand Rapids occurred in 1921 with a mean of 79.7 degrees.

The average temperature of the 36 long- term climate stations in Southwest Lower Michigan was 73.5 degrees, which was 3.3 degrees warmer than normal and the 14th warmest on record (Table 2). This was a big change from July of 2009, which was the coldest July on record for this area with a mean of 65.0 degrees.

Using these same stations, the month was wetter than normal, except for an area near Lansing. Greater totals ranging from 8 to 10 inches extended from south of Jackson, through the Battle Creek area, to between South Haven and Holland.

Severe storms became more frequent during the second half of the month with 49 reports of severe weather. It was the fourth greatest number of severe weather reports since 1985. The most active July since 1985 occurred in 2007 with 61 severe weather reports. The second most active July was in 2002 with 52 severe weather reports. There were two weak tornadoes in July 2010 over Southwest Lower Michigan. Both tornadoes occurred in Allegan County on the 18th and again on the 22nd.

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TABLE 1. Average temperature and precipitation / snowfall totals for July 2010 at the primary climate stations and averaged across Southwest Lower Michigan. Normals are computed from the 1971-2000 30-year average.

Location		Average Temperature (degrees F)	Precipitation (inches)	Snowfall (inches)
Grand Rapids	<i>Reported</i>	75.5	4.66	0.0
	<i>Normal</i>	71.4	3.56	0.0
	<i>Departure</i>	+4.1	+1.10	0.0
	<i>Record Max (year)</i>	79.7 (1921)		
	<i>Record Min (year)</i>			
	<i>Record Max (year)</i>	108 (1936)	8.83 (1992)	0.0
	<i>Record Min (year)</i>	41 (1983)	0.25 (1894)	0.0
Lansing	<i>Reported</i>	74.6	2.00	0.0
	<i>Normal</i>	70.3	2.68	0.0
	<i>Departure</i>	+4.3	-0.68	0.0
	<i>Record Max (year)</i>	77.7 (1955)		
	<i>Record Min (year)</i>			
	<i>Record Max (year)</i>	102 (1934)	11.25 (1883)	0.0
	<i>Record Min (year)</i>	31 (1863)	0.09 (1916)	0.0
Muskegon	<i>Reported</i>	75.0	3.52	0.0
	<i>Normal</i>	69.9	2.32	0.0
	<i>Departure</i>	+5.1	+1.20	0.0
	<i>Record Max (year)</i>	75.9 (1955)		
	<i>Record Min (year)</i>			
	<i>Record Max (year)</i>	99 (1913)	7.11 (1902)	0.0
	<i>Record Min (year)</i>	39 (2001)	0.11 (1916)	0.0

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Temperatures:

Although July 2010 was very warm, there were not many days with highs in the 90s. This likely was compensated by the very high frequency of low temperatures greater than 65 degrees (Table 3). This was a significant factor in the monthly mean being so warm. There was a lack of cold air outbreaks that typically occur over Southwest Lower Michigan.

Averaging the 36 long-term climate stations, the areal mean of 73.5 degrees was 3.3 degrees above normal, making this the 14th warmest July on record. It was also the warmest July since 2002, which averaged 74.0 degrees, or 3.8 degrees above normal. For all of Southwest Lower Michigan, the warmest July on record was in 1921 with a mean of 77.4 degrees.

The Muskegon weather station was at the Muskegon Coast Guard Station and the shelter with the thermometers for that station was on the pier in 1921. It therefore is not surprising that on 4 days with highs in the 90s were recorded (Table 3). By 1955, the site had moved inland to the Muskegon Airport, which allowed for warmer afternoon temperatures on most days.

The July 36 station average of 73.5 degrees was 8.5 degrees warmer than the July 2009 mean of 65.0 degrees. This is the second largest yearly increase recorded from one year to the next for the month of July. The largest recorded increase was 9.9 degrees from 1920 to 1921. This July is only the fourth time on record that there was an increase of at least six degrees. There are four years on record that the mean temperature decreased at least six degrees from one July to the next. The largest decrease was 8.0 degrees in 1921 to 1922, which followed the 9.9 degree increase from 1920 to 1921. The records show that sharp increases in successive Julys have been followed by sharp decreases. It will be interesting to see whether July of 2011 is significantly colder.

The warmest part of the July mean temperature record was in the 1930s (Figure 5). The 30-year running mean peaked with a mean of 71.5°. By the early 1950s the mean fell to between 70° and 71°. Since then it has ranged from near 69° in the late 1960s and as high as 71° in the early 1990's. So the first 50 years of the record averaged around 2° warmer than the most recent 60 years of the record.

Since 1982 there have been six July's with the area mean over 73°, like this July was. However, between 1955 and 1982 there were no years with a mean that high. So, even though the overall mean temperature for July has not warmed significantly over the past 60 years, the most recent 30 years has seen an increased frequency of very warm years. From 1895 until 1955 there were twelve years with a mean of 73 degrees or more. This gives us a mean of 1 per decade from 1895 to 1955, and 2 per decade from 1982 through 2010. The most recent frequency of very warm July's has doubled compared to the first 50 years of the record.

Strangely, at the same time, the frequency of warm July's was increasing, so was the frequency of colder July's has increased since 1982 also. Prior to 1982 there were no July's with an area mean colder than 67 degrees, since 1982 there have been three such July's. Considering the frequency of both extreme cold July's and extreme warm July's has increased significantly since 1982, this shows the climate has indeed become more extreme.

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TABLE 2. July 2010 daily maximum and minimum temperatures at selected climate stations.

	Grand Rapids		Lansing		Muskegon	
	Max	Min	Max	Min	Max	Min
1	77	50	74	45	74	49
2	82	57	81	52	78	57
3	86	57	85	57	82	60
4	92	62	92	62	89	70
5	92	75	92	76	88	76
6	92	71	92	71	88	75
7	92	73	92	71	90	72
8	83	73	84	70	81	73
9	85	67	84	67	86	67
10	87	62	85	60	85	64
11	86	66	86	64	85	67
12	81	68	83	67	80	68
13	83	68	81	66	85	69
14	87	66	87	62	86	66
15	89	69	92	69	84	68
16	88	66	89	63	85	72
17	88	71	89	66	84	72
18	82	67	86	66	83	71
19	83	67	80	69	82	68
20	83	64	82	65	83	64
21	86	67	88	67	83	69
22	79	63	81	61	76	65
23	87	74	90	73	84	74
24	82	72	82	71	80	72
25	83	67	80	64	84	66
26	85	63	85	60	82	60
27	86	62	85	61	85	64
28	85	70	86	68	82	70
29	82	61	81	57	80	61
30	82	60	83	57	81	60
31	80	68	78	66	80	69

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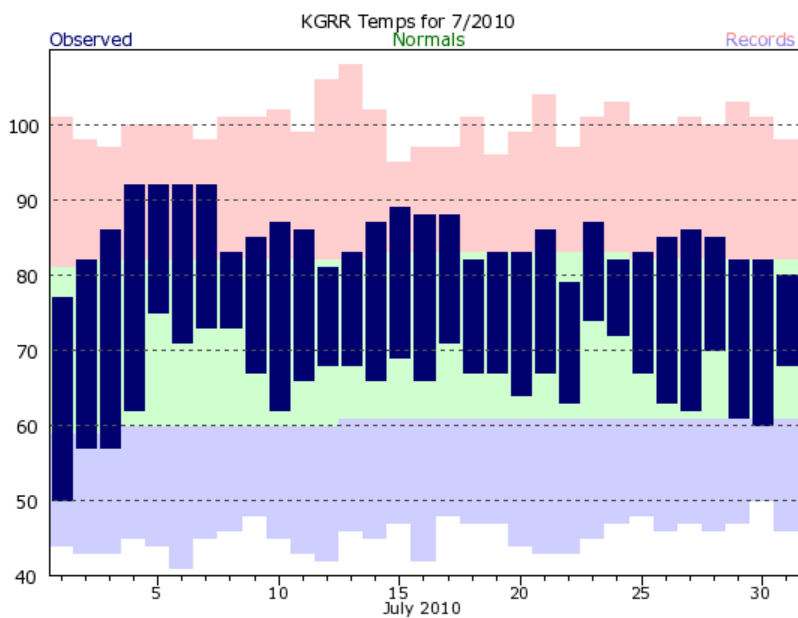


FIGURE 1. Observed temperatures(degrees F) at the Grand Rapids International Airport. Dark blue bars are the temperature range for each day. The green strip indicates the normal range of temperatures. Record high and low temperatures are indicated at the top of the pink area and the bottom of the blue area, respectively. Normals computed as in Table 1.

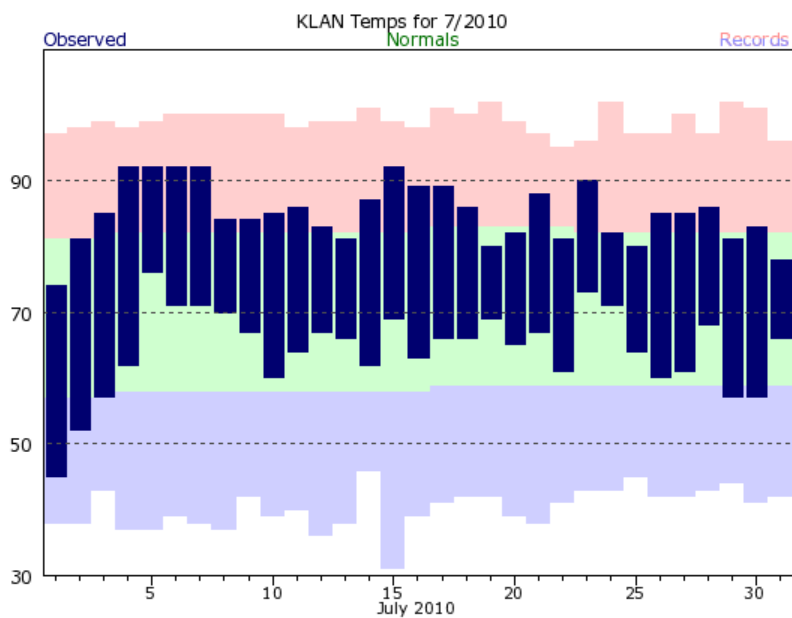


FIGURE 2. As in FIGURE 1, except for the Lansing airport.

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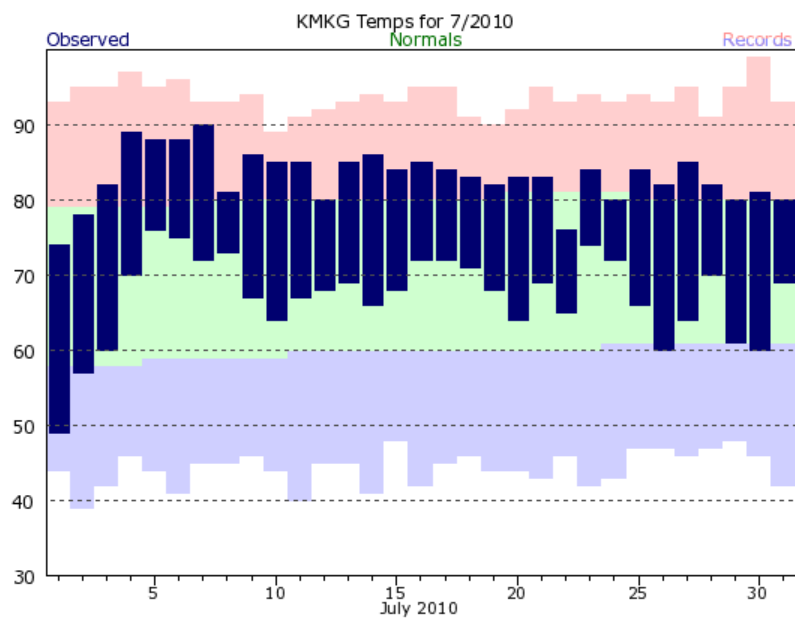


FIGURE 3. As in FIGURE 1, except for the Muskegon airport.

Average Temperature Departure from Mean in Degrees F
July 1, 2010 to July 31, 2010

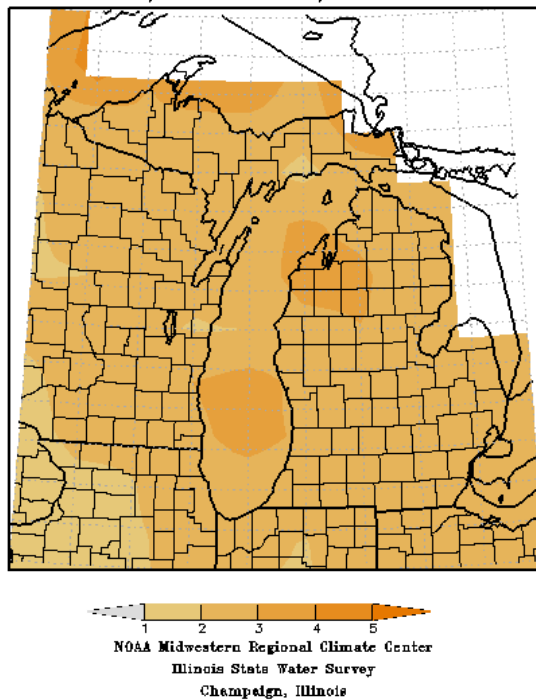


FIGURE 4. Average temperature departure (degrees F).

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TABLE 3. July 2010 temperature frequencies at the primary climate stations.

Number of days	Grand Rapids	Lansing	Muskegon
<i>highs ≥ 90 (2010)</i>	4	6	1
<i>highs ≥ 90 (2009)</i>	0	0	0
<i>highs ≥ 90 (normal)</i>	5.3	4.2	0.9
<i>highs ≥ 90 (record)</i>	18	18	13
<i>year(s) of record</i>	1921	1955	1955
<i>highs ≥ 80 (2010)</i>	29	28	28
<i>highs ≥ 80 (2009)</i>	11	11	4
<i>highs ≥ 80 (normal)</i>	21.9	21.4	17.4
<i>highs ≥ 80 (record)</i>	31	31	31
<i>year(s) of record</i>	1955	1951	1955
<i>lows ≥ 70 (2010)</i>	8	6	11
<i>lows ≥ 70 (2009)</i>	0	0	0
<i>lows ≥ 70 (normal)</i>	2.8	2.3	2.4
<i>lows ≥ 70 (record)</i>	14	8	13
<i>year(s) of record</i>	1901,1921	1977, 1987	1931
<i>lows ≥ 65 (2010)</i>	20	17	22
<i>lows ≥ 65 (2009)</i>	1	1	1
<i>lows ≥ 65 (normal)</i>	9.3	8.0	8.9
<i>lows ≥ 65 (record)</i>	26 (1921)	24 (1955)	22 (2010)
<i>lows < 60 (2010)</i>	3	5	2
<i>lows < 60 (2009)</i>	21	23	22
<i>lows < 60 (normal)</i>	13.3	16.3	13.7
<i>lows < 60 (record)</i>	22 (1992)	27 (1865)	26 (1927)

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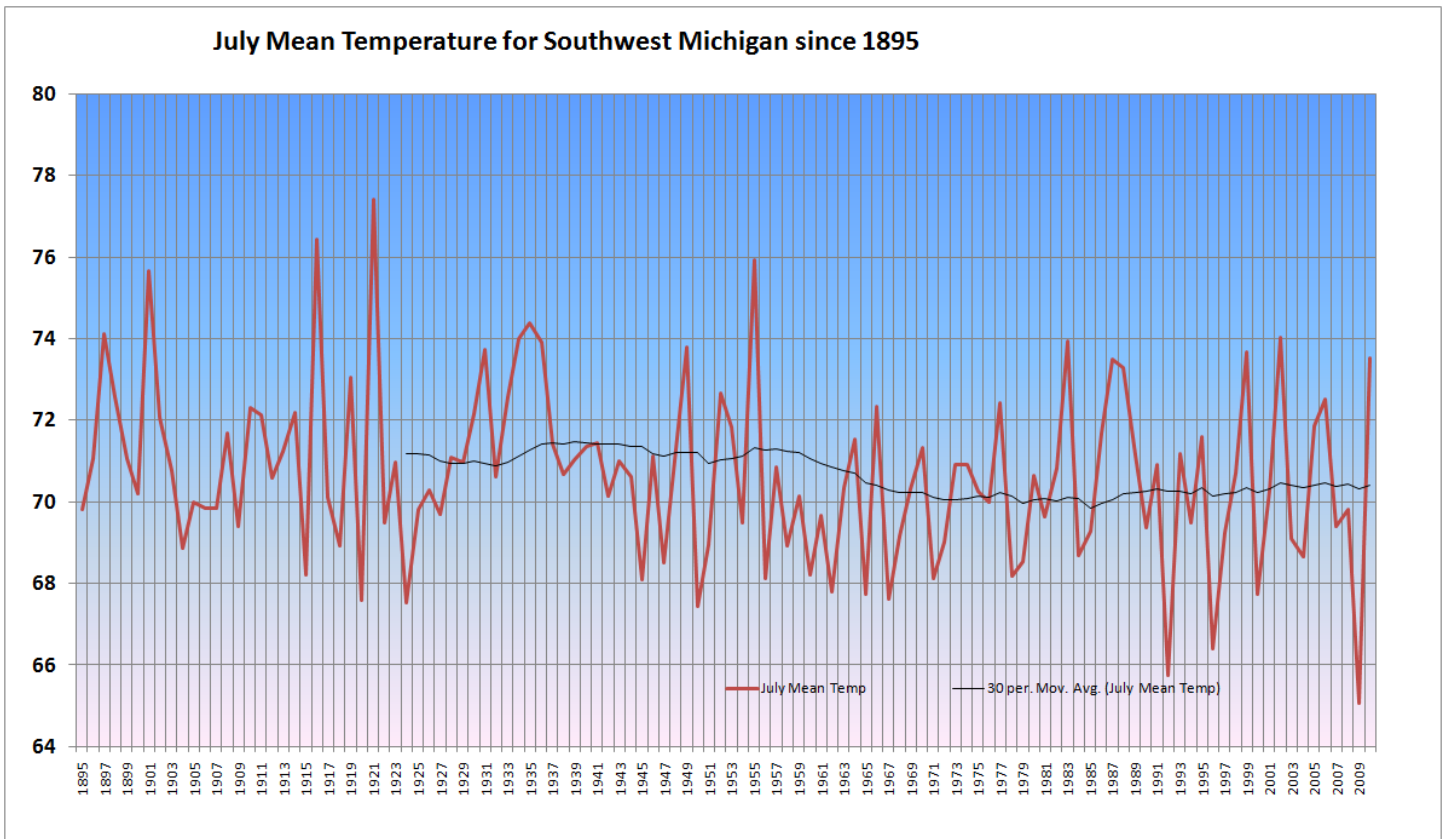


FIGURE 5. Annual average temperatures for the 36 long-term climate stations and the 30-year running mean.

Precipitation:

At the selected climate stations, precipitation ended slightly above normal for July of 2010, except for Lansing (Table 1, Figures. 6-8). After a nearly normal pace, heavy rain on the 22nd kept Grand Rapids and Muskegon above normal for the rest of the month. The heaviest rainfall extended from near Jackson through the Battle Creek area to between Holland and South Haven (Figures. 9 and 10). It was in this area that a nearly stationary front provided a focus for thunderstorms late in the month.

Looking at the 36 station average rainfall going back to 1895 (Figure 11), 1950 to 2010 experienced a greater frequency of heavy rainfall months than 1900 to 1949. The frequency of Julys greater than one standard deviation above normal prior to 1950 was about one per decade. After 1950, the rate increased to 2.5 years per decade. There is a similar decrease in the frequency of very dry years comparing the years prior to 1950 to the years after 1950.

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TABLE 4. July 2010 daily precipitation totals at the primary climate stations.

	Grand Rapids	Lansing	Muskegon
1	0.00	0	0
2	0.00	0	0
3	0.00	0	0
4	0.00	0.01	0
5	0.00	0	0
6	0.12	0	0
7	0.00	0	0
8	1.22	0.39	0.29
9	T	T	0
10	0.00	0	0
11	0.05	0.01	0.12
12	0.27	0.06	0.01
13	0.00	T	0.21
14	T	0	T
15	0.06	0.05	0.51
16	0.00	0	0
17	0.00	0	0
18	0.24	T	0.36
19	0.13	0.02	0.08
20	0.46	0.01	0.02
21	0.00	0	0
22	1.55	1.24	1.39
23	0.15	0.08	0.06
24	0.38	0.12	0.45
25	0.00	T	0
26	0.00	0	0
27	0.00	0	0
28	0.03	0.01	T
29	0.00	0	0
30	0.00	T	0
31	T	0	0.02

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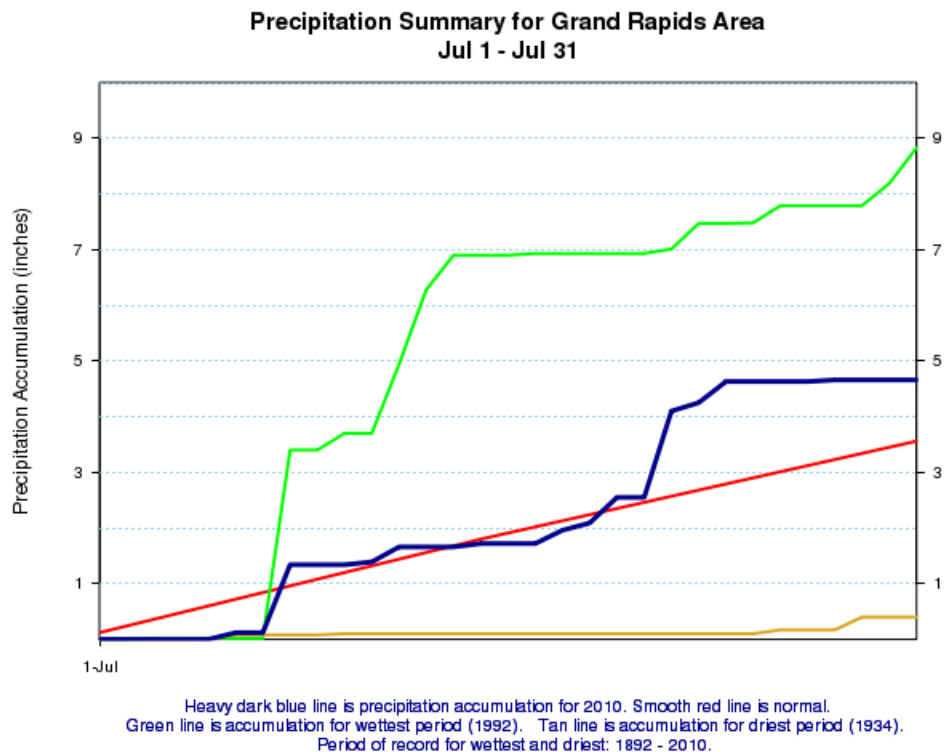


FIGURE 6. July 2010 precipitation accumulation for Grand Rapids.

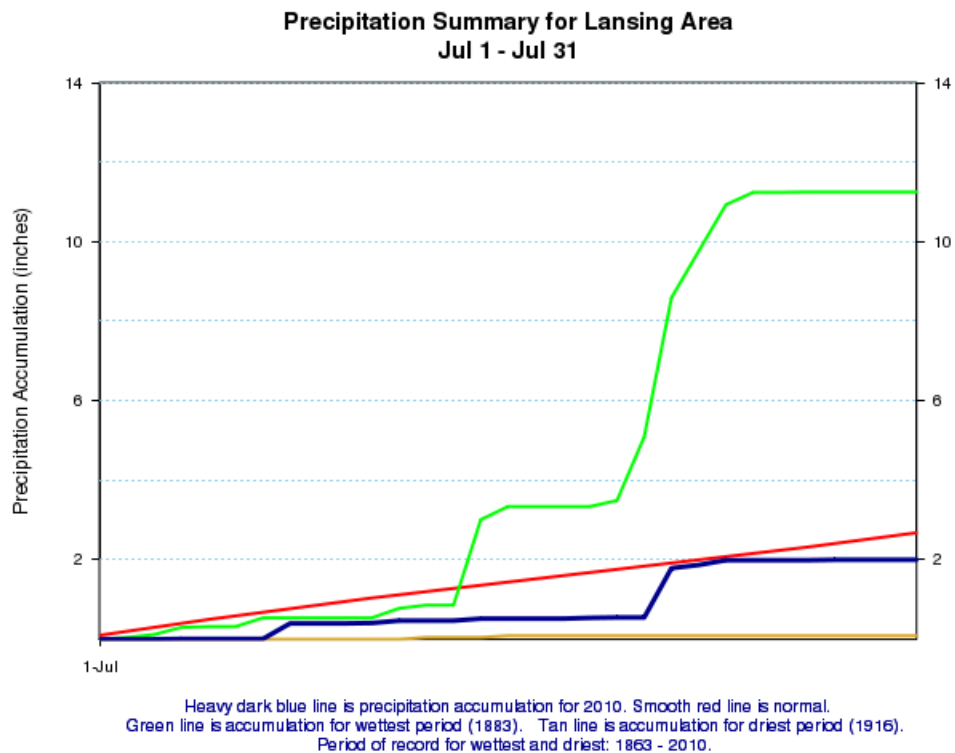


FIGURE 7. As in FIGURE 6. except for Lansing.

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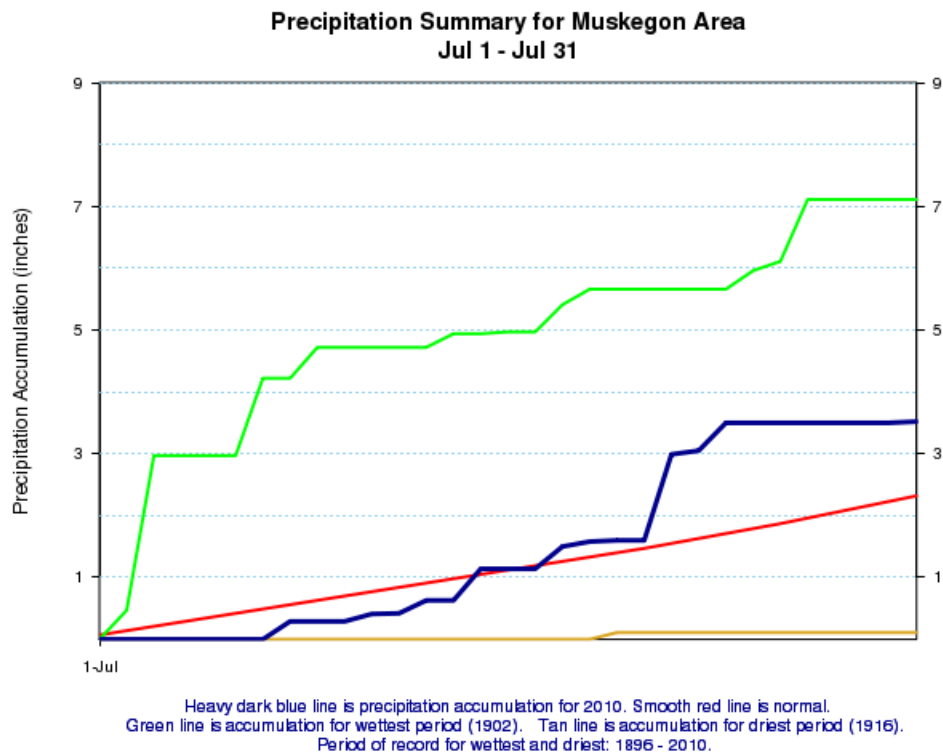


FIGURE 8. As in FIGURE 6. except for Muskegon.

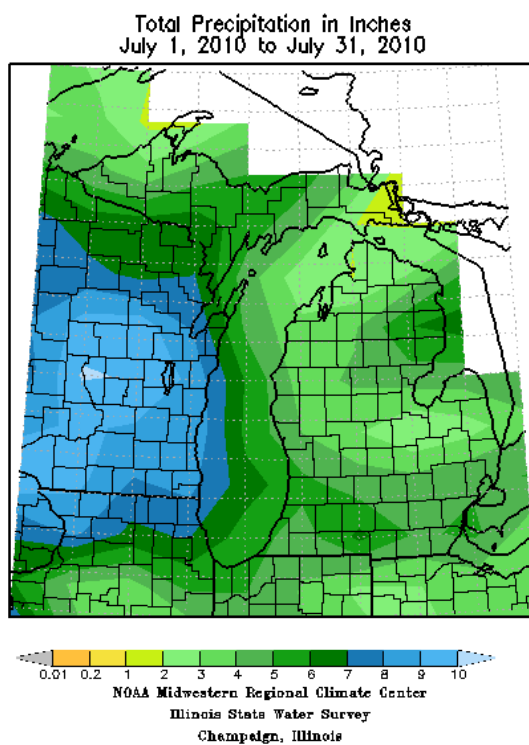


FIGURE 9. July 2010 total precipitation (in inches).

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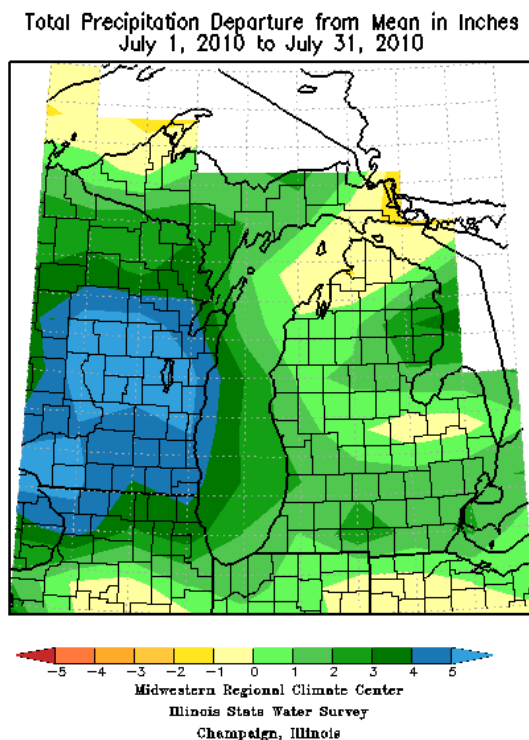


FIGURE 10. Average precipitation departure (in inches) for July 2010.

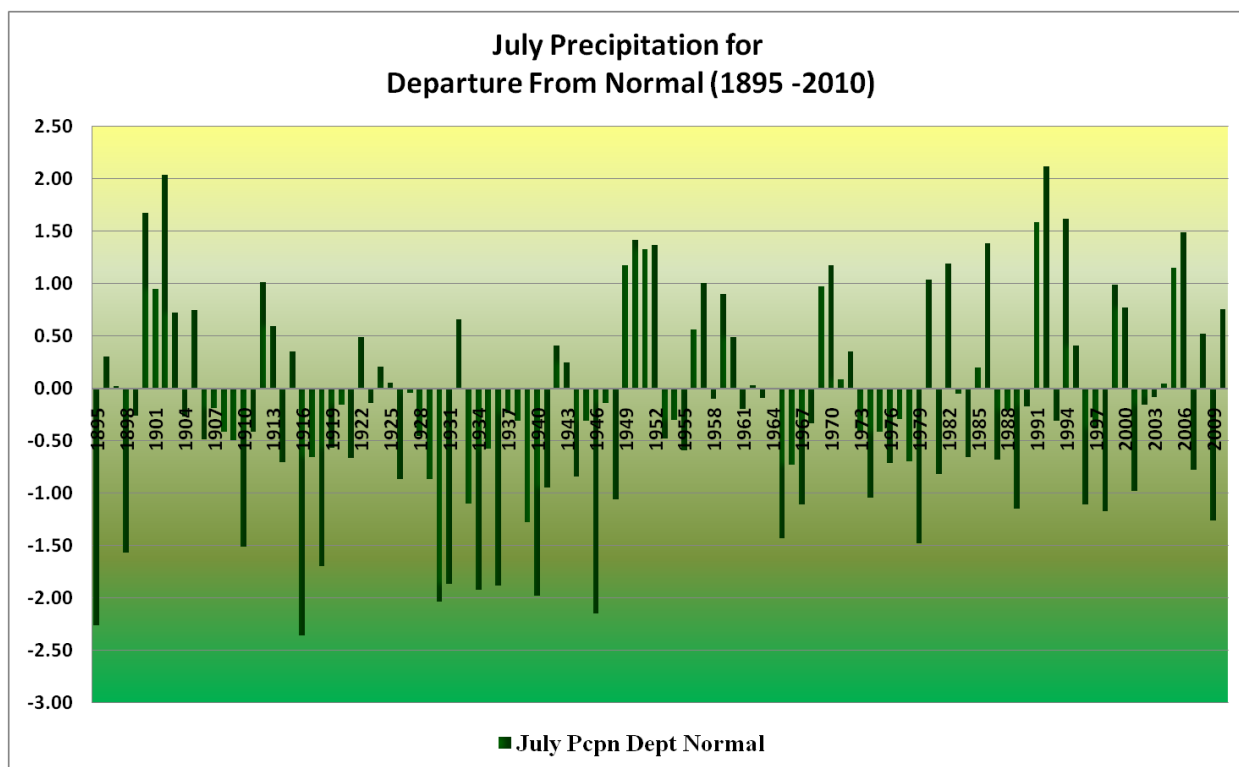


FIGURE 11. July precipitation departure from the 1971 – 2000 normals for the years 1895 - 2010 using the 36 long term climate stations.

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Severe Storms:

The frequency of both severe storms and the number of episodes of severe storms was well above average in July 2010 (Table 5). The number of severe events over Southwest Lower Michigan is much greater than July of 2009, which was second lowest total since 1986 to 2010 (Figure 12). Only three years since 1986 recorded more severe weather events: 2003 (52), and both 2004 and 2008 (61). Four severe weather episodes occurred for the month, which is just above the average. Only two years since 1986 recorded more episodes: 2003 (7) and 2005 (5).

TABLE 5. Reported severe weather events and episodes across Southwest Lower Michigan. An episode is defined as three or more events within 6 hours.

<i>Events (2010)</i>	49
<i>Events (2009)</i>	4
<i>Events (1986 – 2010 average)</i>	26
<i>Events (record)</i>	61
<i>year(s) of record</i>	2004, 2008
<i>Episodes (2010)</i>	5
<i>Episodes (2009)</i>	3
<i>Episodes (1986 – 2010 average)</i>	5
<i>Episodes (record)</i>	7
<i>year(s) of record</i>	2003

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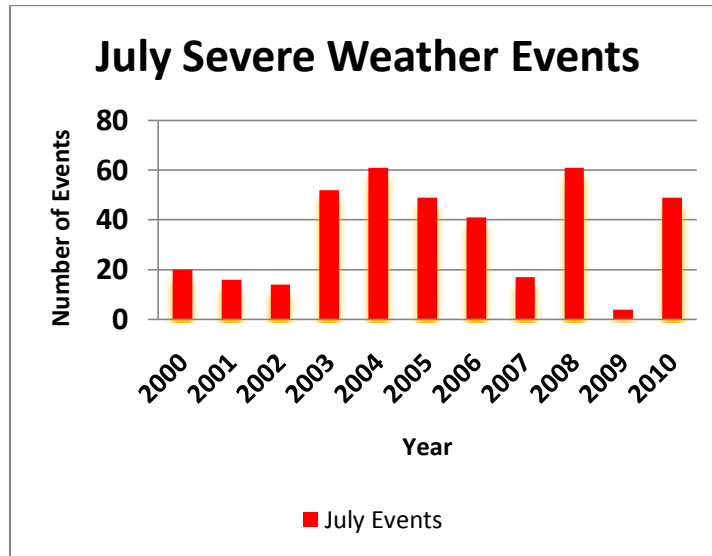


FIGURE 12. The total number of severe weather events from 2000 to 2010 across Southwest Lower Michigan.

Highlights of the month of July 2010

1st

A large Canadian high pressure system brought morning low temperatures down into the 40s to around 50 degrees (Figures. 1-3). Leota in Clare County reported a low of 32 degrees and Big Rapids reported 39 degrees. For all three of the primary climate stations, the 1st was the coolest day of the month and the only day with a daily mean temperature more than five degrees below normal. At Muskegon it was the only day of the month colder than normal.

4th – 7th

The hottest part of the month occurred when highs were in the 90s each day for Grand Rapids and Lansing. Due to its proximity to Lake Michigan, Muskegon did not reach 90 degrees and of those days.

8th

The first heavy rainfall event of the month occurred, dropping 1.22 inches at Grand Rapids and over an inch across surrounding areas (Table 3, Figure 13).

9th – 14th

A series of weak frontal systems brought scattered thunderstorms to the area, but no severe weather was reported and highs remained mostly in the mid 80s.

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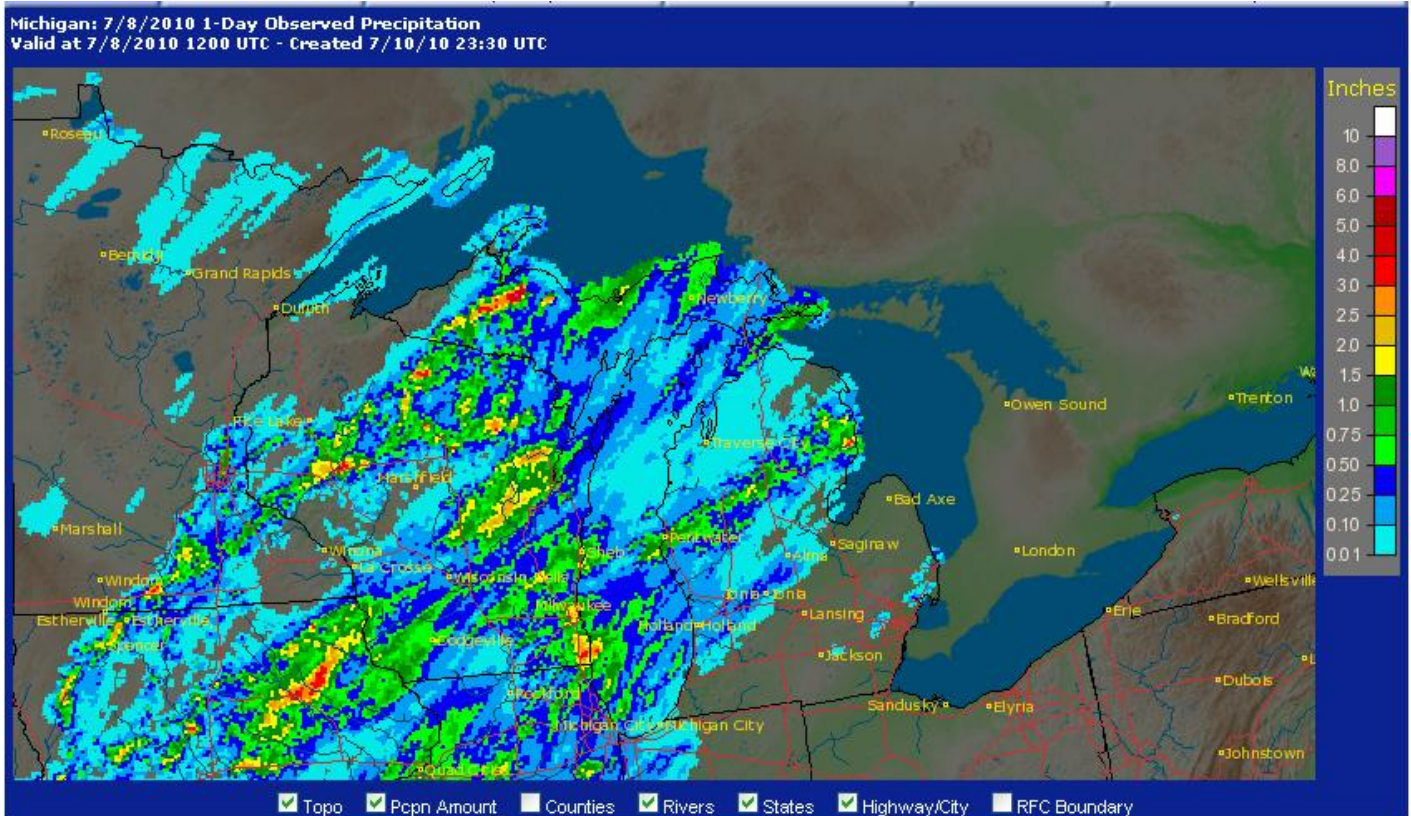


FIGURE13. Rainfall event on July 08th from 8 AM through July 09th at 8 AM.

15th

A strong storm system brought the first severe weather episode to the area during the afternoon (Figure 13). Seventeen damaging wind events between 2:52 PM and 5:25 PM EDT were reported. Heavy rain occurred across Wisconsin and into extreme western Lower Michigan (Figure 14). Behind this system, temperatures warmed to the upper 80s to near 90 from the 15th through the 17th.

18th

A stronger cold front brought the second severe weather episode to Southwest Lower Michigan (Figure 15). This also occurred in the afternoon. Eleven damaging wind events between 3:45 PM and 5:10 PM were reported. An EF-0 tornado occurred avenue in northeastern Allegan County near 144th Street and 2nd Street at 408 pm. The tornado was approximately 50 to 75 yards wide with a path length of 0.34 miles. It was on the ground for approximately 2 minutes.

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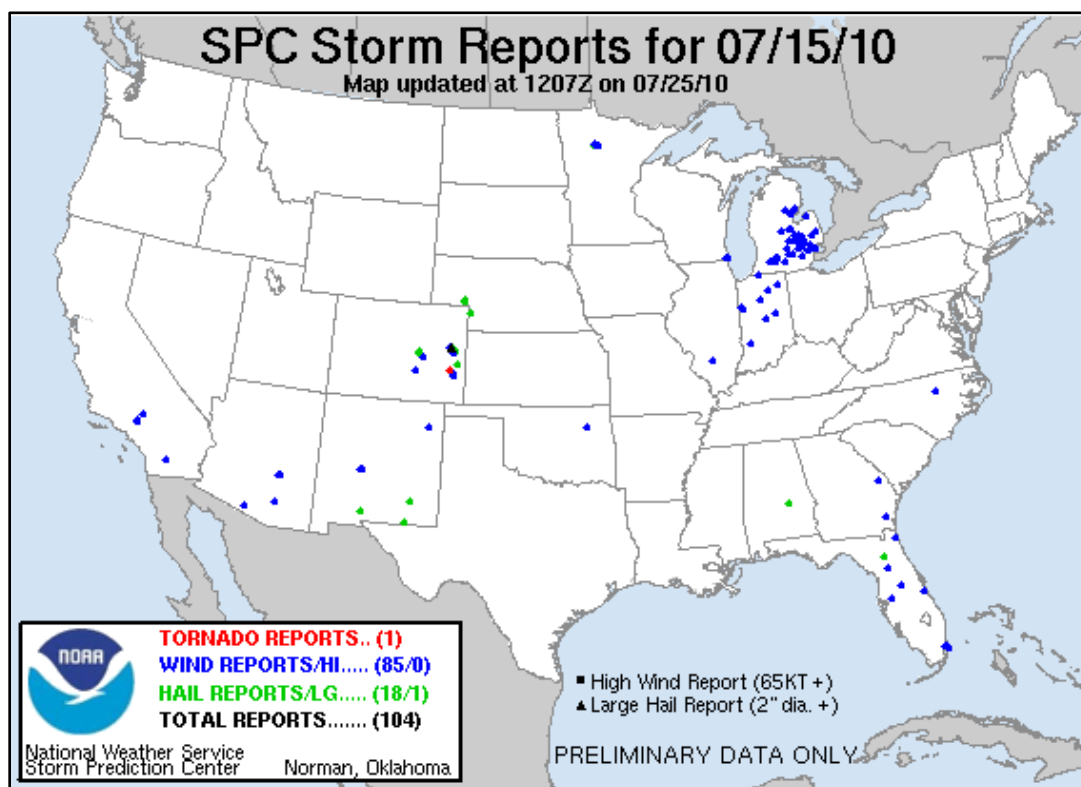


FIGURE14. Severe storms on July 15th from 8 AM through July 16th at 8 AM.

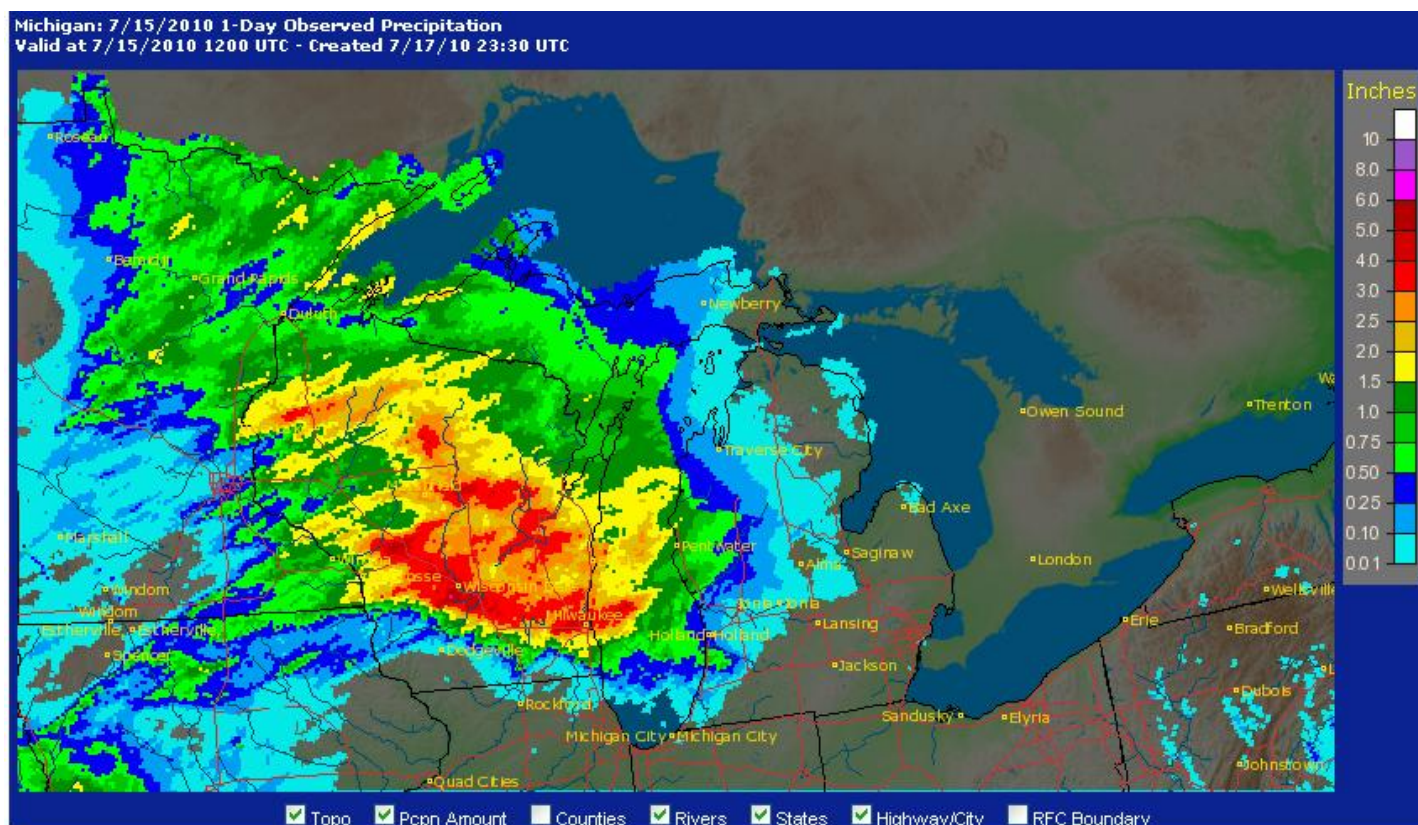


FIGURE 15. Rainfall event on July 15th from 8 AM through July 16th at 8 AM.

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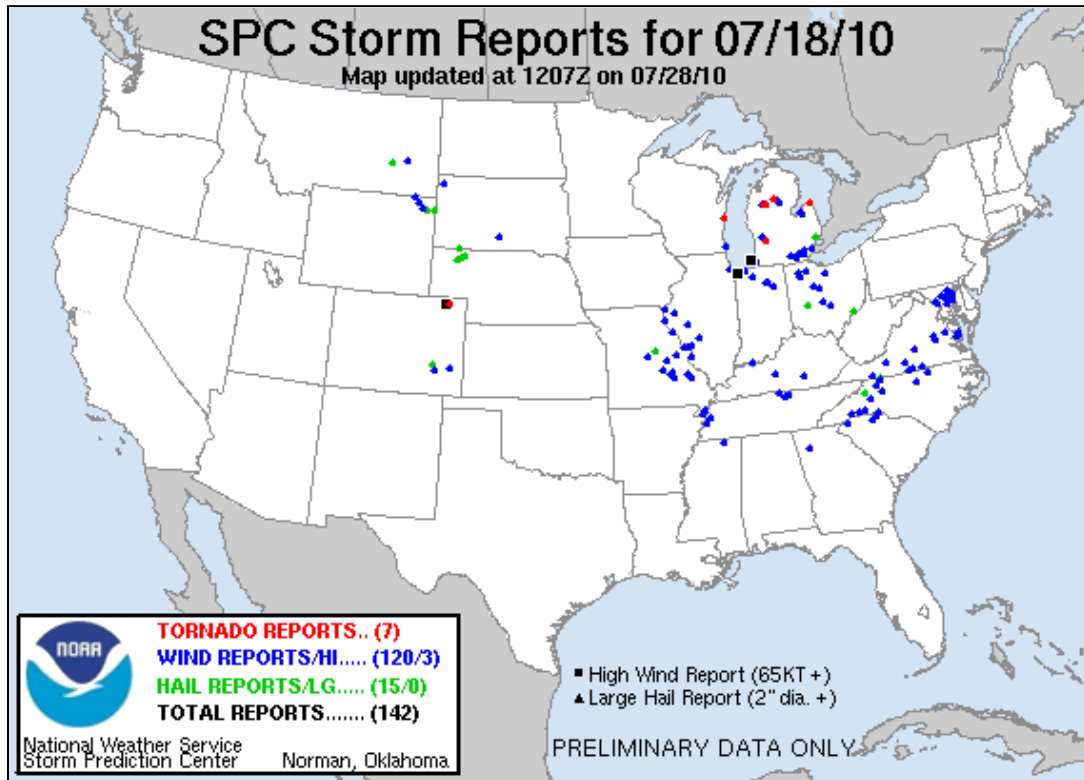


FIGURE 16. Severe storms on July 18th from 8 AM through July 19th at 8 AM.

22nd

A front stalled south of Lower Michigan moved back north to near Interstate 80. This provided the focus for the next severe weather episode, consisting of ten damaging wind events between 3:00 PM and 4:45 PM. The final and fourth episode of July occurred later in the day, and consisted of six damaging wind events one large hail event between 9:57 PM and 11:45 PM EDT. A brief EF-0 tornado touched down in central Allegan County at approximately 10:23 pm. This tornado was on the ground for approximately 0.16 miles and had a width around 50 yards. During these episodes, heavy rain fell near and north of Route 10 and near and south of Interstate 96 (Figure 17). The three primary climate sites reported the most rain on this day (Table 3). Some flooding was reported from this event and the Kalamazoo River rose to near flood stage.

22nd – 25th

The front continued to oscillate north and south across the area. During this time, Battle Creek received 2.41 inches of rain on the 22nd and 2.40 inches on the 23rd. This caused flooding and temporary street closures. Two more damaging wind events occurred between 5:35 PM and 6:00 PM on the 23rd. Localized Flooding to the Interstate 94 area was reported from the 24th into the 25th. Rainfall totals for this period totaled around two to five inches just south of Interstate 94 between Jackson and Kalamazoo (Figure 21). The Kalamazoo River reached near flood stage during this time, which was especially significant because a major oil spill into the Kalamazoo River commenced on the 27th.

28th

The month closed with another cold front coming through the area. This brought more thunderstorms with two more damaging wind events between 1:23 PM and 2:11 PM EDT. High temperatures remained in the lower to mid 80s through the end of the month (Figures 1-3).

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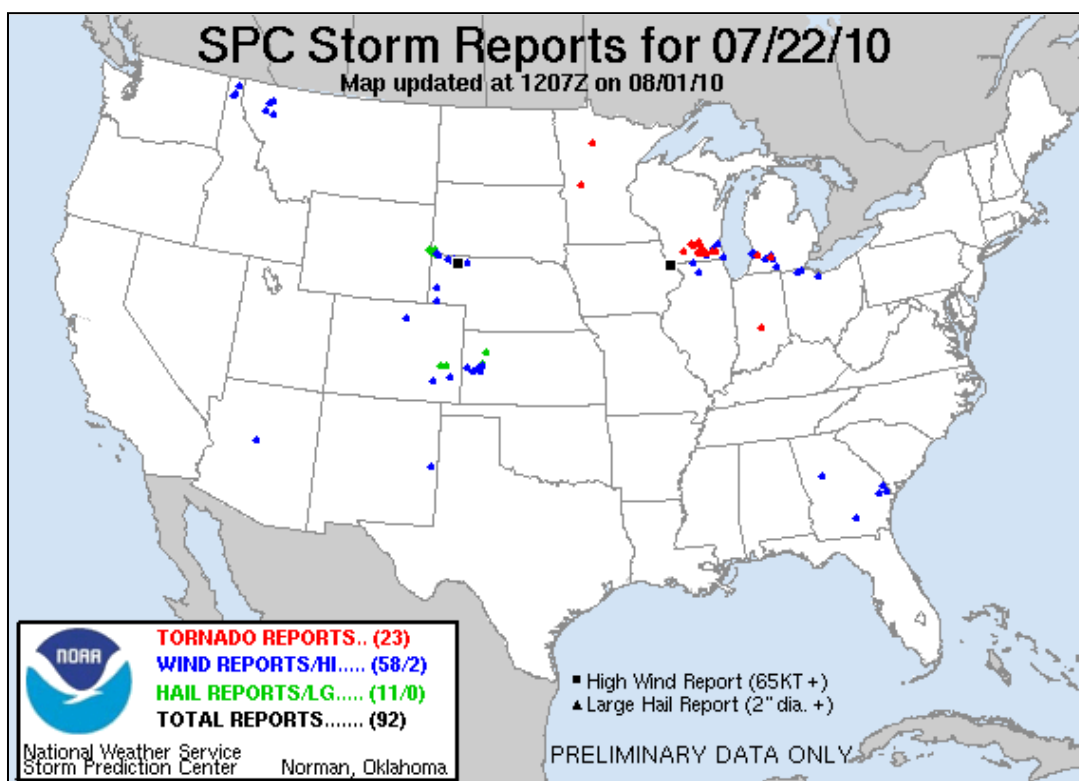


FIGURE 17. Severe storms on July 22nd from 8 AM through July 23rd at 8 AM.

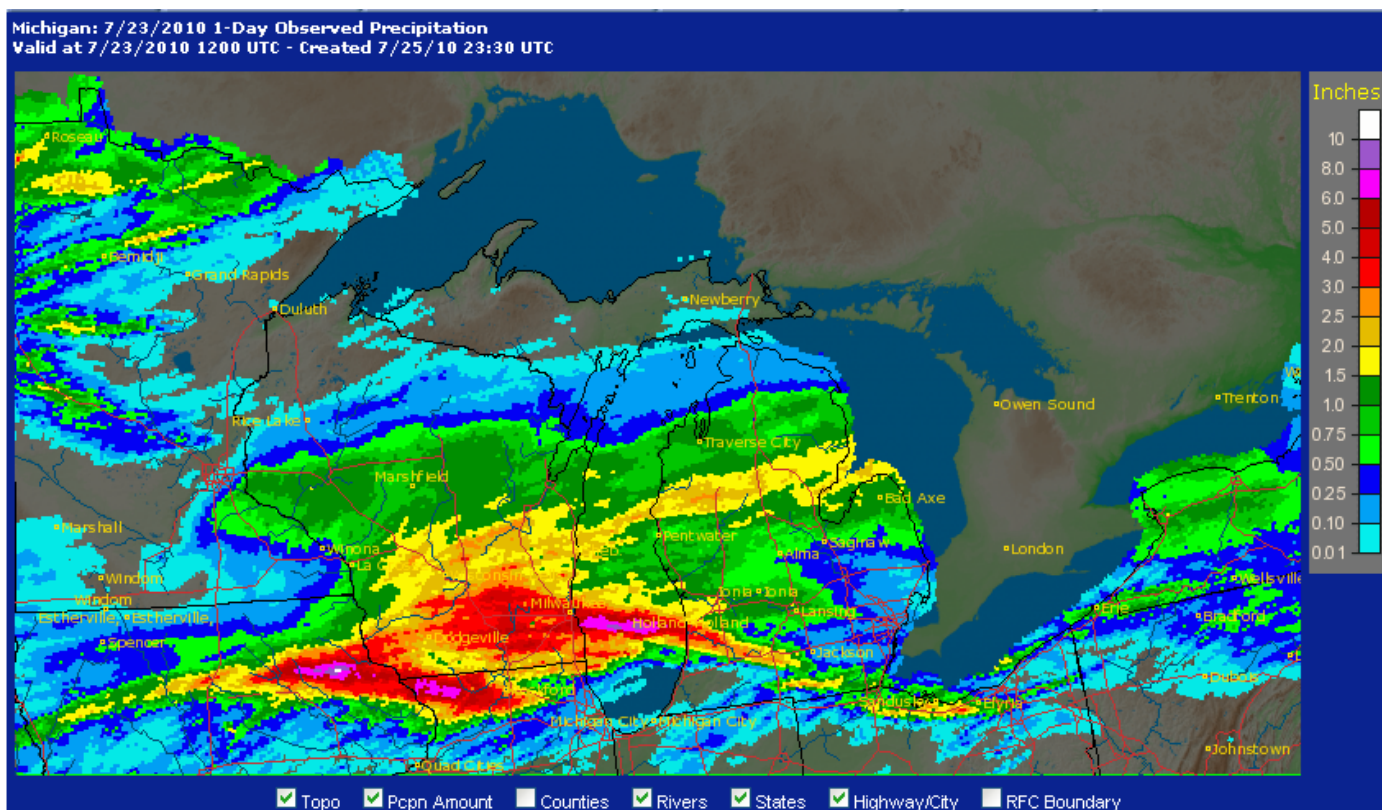


FIGURE 18. Rainfall event on July 22nd from 8 AM through July 23th at 8 AM. Note the band of heavy rain from near South Haven to Jackson.

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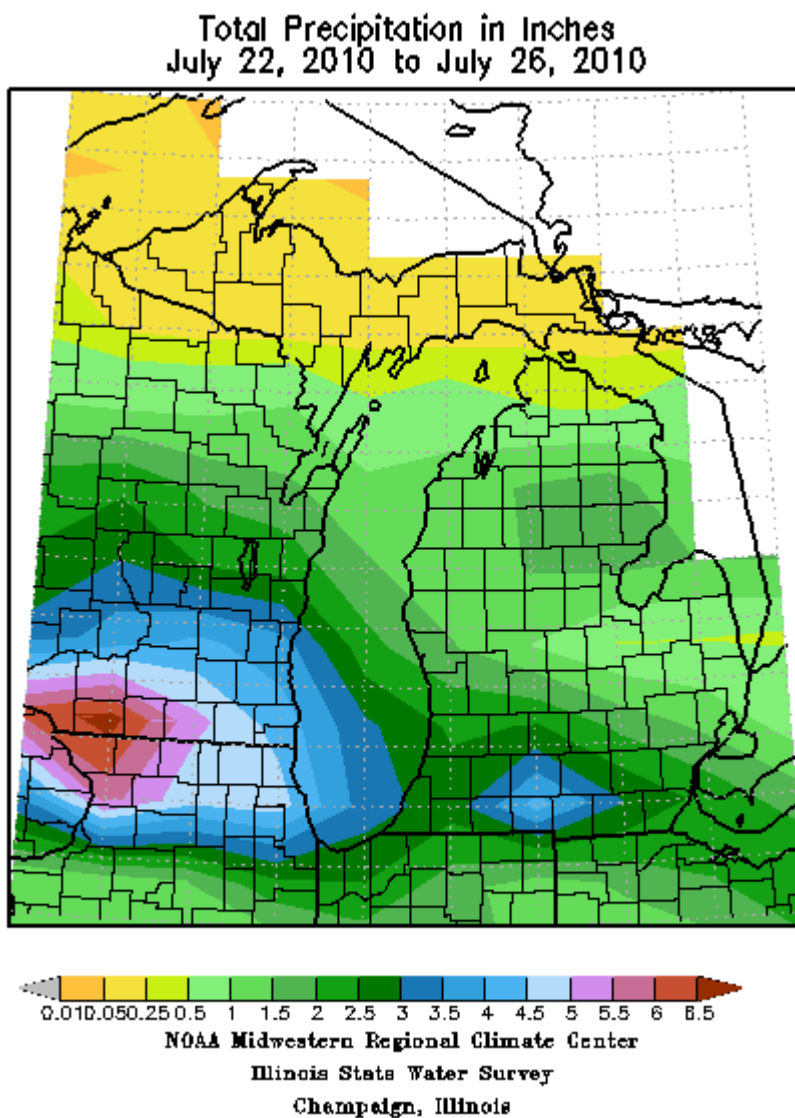


FIGURE 21. Storm total rainfall from the 22nd at 8 AM EDT through the 26th at 8 AM EDT. Note the heavy rainfall just south of Interstate 94 from Jackson to Kalamazoo.